A MODERN PHYSICAL LABORATORY.

IN December of last year were opened at Göttingen a number of fine new buildings to accommodate the different subdivisions of the physical department of the University An account of these has just been published in a volume issued under the auspices of the Göttingen Association for the Promotion of Applied Physics and Mathematics.[1] This book, a handsome quarto of 200 pages containing numerous illustrations and plans, gives a graphic idea of the elaboration which is now considered necessary for the successful carrying out of work in the different branches of this most rapidly developing science.

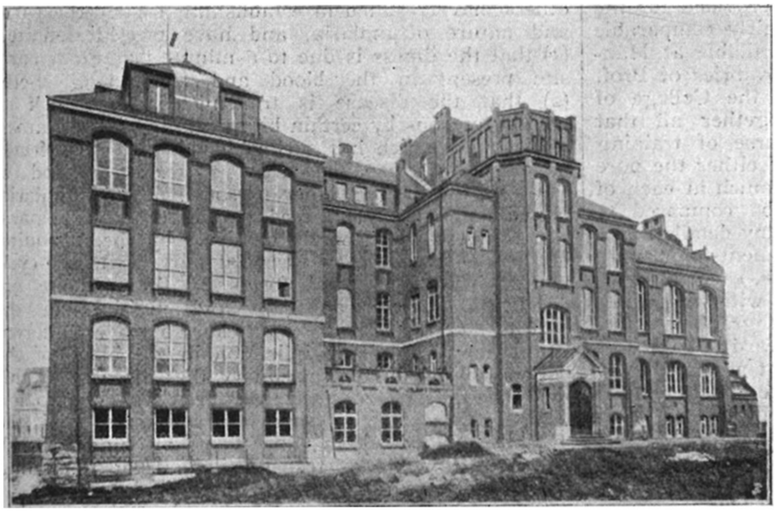

FIG. 1.—North Side of the Physical Institute, University of Göttingen.

Many physicists can remember the time when, even in the most progressive of our universities, where large and well-fitted chemical laboratories had long been established, the accommodation accorded to experimental physics consisted of two or three very ordinary rooms, with perhaps a stone pillar or two for galvanometers or cathetometer, and a wide shelf outside the window for the Grove or Bunsen batteries. By and by came a few accumulators, possibly home-made from jam-pots and roofing lead, the charging arrangements for these consisting of a dynamo of perhaps 25 per cent. efficiency and a gas engine, the obstinacy of which in starting on a winter's morning still calls up recollections. A pressure of 100 volts was to be treated with great respect, and no laboratory resistance-coil was made to carry more than a few amperes. Nowadays it is impossible satisfactorily to house the various subdivisions of experimental physics in a single building, however palatial, and at Göttingen five separate and distinct "institutes" have been provided.

The speeches at the opening ceremony of the directors of each of these institutes sketch in an interesting and eloquent fashion the evolution of the whole from its small beginnings, and review in succession the many honourable names which, from Gauss and Weber down to our own times, have been associated with the progress of physics at Göttingen. Prof. Riecke, speaking as head of the parent laboratory of pure physics, mentions how rapid was the increase, during the closing fifteen years of last century, of work on the borderland between physics and chemistry, of the type in which Ostwald and Victor Meyer were pioneers. This led to the foundation of a separate physical-chemical institute under the direction of Prof. Nernst. Again, the expansion of applied physics and of electrotechnics, particularly in its developments for lighting and power purposes, was so rapid that in 1898, with the aid of the Göttingen Association for the Promotion of Applied Physics and Mathematics, an annexe to the main physics laboratory was erected. This developed later with the help of substantial Government grants into the present institute for applied electricity, and when the new physical laboratory was erected the old building was constituted the institute for applied mathematics and mechanics.

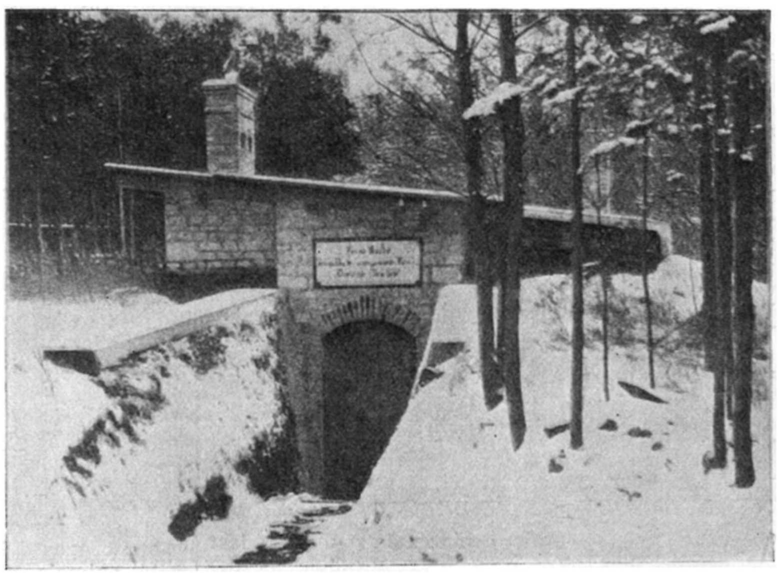

FIG. 2.—Seismological Station, University of Göttingen.

A similar evolution from earlier beginnings has been the history of the department for geophysics, the child of the observatory for the study of terrestrial magnetism founded by Gauss. In a historical *résumé* by Prof. Wiechert is quoted a very interesting letter of Gauss to Olbers in 1833, in which he

[1] "Die physikalischen Institute der Universität Göttingen." Festschrift, 1906. Pp. iv+200. (Leipzig and Berlin: B. G. Teubner, 1906.)

describes his early experiments in telegraphy over a distance of a mile and a half. The equipment of the seismographic department of the geophysical institute is in every way unique, and the new earthquake house built by Prof. Wiechert in 1902 is probably one of the finest in the world.

It is beyond the scope of this article to go into detail on each of these developments, but a study of the volume shows that the facilities provided for the student at Göttingen appear to be fairly comparable in a general way with those now available at Manchester, where the splendid new laboratories of Prof. Schuster at the University, and of the College of Technology in the city, provide together all that could be desired for a complete course of training and research in almost any branch of either the pure or applied science. Though there is much at each of the two universities which cannot be compared to any similar thing at the other, yet many details make the resemblance between the equipments for pure physics distinctly striking; for example, each possesses a large concave Rowland grating, with mounting specially designed for accurate photographic work, made by Krupp and by Sir Howard Grubb respectively. The magnificent equipment at Manchester has already rendered excellent service in the hands of Mr. Duffield in his investigation of the effect of pressure on arc spectra.

The volume under review is well got up, and though considerable space is taken up with purely descriptive detail, there is much matter in it of real interest; for example, many passages in the speeches delivered at the opening ceremony sparkle in a manner not usual in such efforts. We conclude with a translation of some extracts from the address of Prof. Voigt. He says:—

"What is it, then, which fetters the crystallographer so strongly to his science? I will try to explain it by a parable.

"Let us imagine in a large hall a couple of hundred brilliant violin-players, who all play the same piece with instruments faultlessly tuned, but commence simultaneously at all sorts of different places, and perhaps at the conclusion begin over again. The effect is (at least for Europeans) not exactly pleasant, a monotonous jumble of sounds, in which even the finest ear is unable to recognise what is being played. . . . Such music the molecules of gaseous, liquid, and ordinary solid bodies make for us. They may be highly gifted molecules with marvellous internal architecture, but in their activity each disturbs the others. . . . A *crystal* on the contrary corresponds to the orchestra above described, when the same is led by a vigorous conductor, when all eyes intently watch his nod, and all hands follow the exact beat. . . This picture renders it understandable how crystals can exhibit whole ranges of phenomena, which are absolutely lacking in other bodies. . . . In my opinion the music of physical law sounds forth in no other department in such full and rich accord as in crystal physics."

J. A. HARKER.

THE ETIOLOGY OF SLEEPING SICKNESS.[1]

AMONG the scientific achievements of the last decade, few have been so remarkable as the rapid increase of knowledge with regard to the minute animacules termed by zoologists Protozoa. More especially is this true as concerns the parasitic members of the group and their relation to disease in man and beast. It is now known that protozoan parasites are the cause of many diseases, especially in the tropics, and as a type of such we may refer to malaria, since the etiology of this disease is now so thoroughly known that it may serve as a model, as it were, of diseases due to Protozoa, and at the same time furnishes valuable analogies and suggests the problems to be investigated in other cases.

The classical researches of Laveran, Ross, and others have resulted in establishing clearly the cause and nature of malaria, and have proved definitely (1) that the illness is due to a minute protozoan parasite present in the blood and multiplying there; (2) that the disease is transmitted from sick to healthy persons by certain biting gnats or mosquitoes, a mosquito which has sucked blood from an infected person being capable, after a certain period of time, of inoculating other persons with the malarial parasite at subsequent feeds; and (3) that the parasite is not carried merely passively by the mosquito, but passes through an essential part of its life-cycle within it, since sexual forms of the parasite are developed which conjugate and multiply in the digestive tract of the mosquito in a manner different from the mode of multiplication in the blood of the patient. It is not extraordinary that diseases of this type should be especially prevalent in the tropics, where insect life is so richly developed, and the numerous blood-sucking insects of all kinds furnish the requisite means of transmitting and disseminating the parasitic micro-organisms.

Since Livingstone's time it has been known that horses and cattle in Africa die from a disease produced by the bites of the indigenous tsetse-flies. These flies, of which eight species are now known, belong to the genus Glossina, a genus of Diptera or two-winged flies characteristic of the African fauna, and not found on other continents. The disease which they produce, termed nagana, or tsetse-fly disease, is rapidly fatal to imported cattle or horses, but does not affect human beings. Various suppositions were put forward as to the nature of the malign power exerted by the dreaded tsetse-fly until the discoveries of Bruce solved the problem once and for all. Bruce found that the disease is caused by the presence in the blood of a minute flagellated organism belonging to the genus of parasitic Protozoa already known to zoologists by the name Trypanosoma, and that the parasite is transmitted from sick to healthy animals by the bite of the tsetse-fly, which was thus shown to play a part in the dissemination of nagana analogous to that played by the mosquito in the dissemination of malaria. Bruce's researches established for nagana the first two propositions stated above for malaria, but it remained to be proved whether the parasite did or did not undergo a definite developmental cycle in the tsetse-fly, as the parasite of malaria does in the mosquito. Bruce discovered, however, another fact of great importance, namely, that the "trypanosomes" of nagana are to be found in the blood of indigenous wild game, such as antelopes and buffaloes, to which the parasites appear to be innocuous. These infected wild animals serve, however, as a reservoir for the disease, the trypanosomes being conveyed by the tsetse-fly from the indigenous wild animals to the susceptible domestic animals. No such natural "reservoir" has been proved as yet for the malarial parasite, though its existence has often been suspected.

It had long been known that negroes from the west coast of Africa were liable to a slow but fatal disease, which, from the peculiar comatose symptoms seen in the final stages, was termed the sleeping sickness. Nothing was known as to the nature of this

[1] "*Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes (Preliminary Report)." By E. A. Minchin, A. C. H. Gray and the late F. M. G. Tulloch. With 3 plates, 1 map and 11 text-figures (Proc. Roy. Soc., 1906.)